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A description is presented of the present state of development of a capital allocations formula for general building project costs at the University of Toronto. The first part of the paper is devoted to a discussion of the objectives and application of the formula in its present state. A detailed description of the available data and the derivation of the proposed formula is presented in the appendix. (FS)

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UNIVERSITY OF TORONTO

OIR-14

DEVELOPMENT OF A

CAPITAL ALLOCATIONS FORMULA

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U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

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OFFICE OF INSTITUTIONAL RESEARCH

The attached paper, OIR-14, Development of a Capital Allocations Formula by I. Thompson, T. DaSilva and B. L. Hansen, describes the present state of development of a capital allocations formula by the Office of Institutional Research at the University of Toronto.

In a memorandum to members of the Joint Capital Studies Committee, November 20, 1963, Dr. D. T. Wright, Chairman, Committee on University Affairs discussed the pressing need for a capital grants formula, and outlined some aspects of developing and applying such a formula. He suggested that capital funds could be provided under several distinct categories.

" (a) For general building projects costs (excluding building for residential purposes, excluding, for the time being, buildings for health sciences, excluding equipment, excluding land acquisition, and excluding general site services, but including all design costs, project management costs, contingencies and so forth, and that portion of site development necessary for connecting building services and for landscaping of the immediate building "surround").

(b) For building for health sciences.

(c) For equipment for initial installation.

(d) For renewal and/or renovation of existing buildings.

(e) For the replacement of buildings judged to be obsolete.

(f) For land acquisition and site development."

The capital allocations formula outlined in OIR-14 covers only the category of general building project costs from the above list. The first part of the paper is devoted to a discussion of the objectives and application of the formula in its present state. A detailed description of the available data and the derivation of the proposed formula is presented in Appendix A.

It is our hope that a formula such as we are proposing would be applied to all provincially-assisted universities in the Province of Ontario. However, at this stage of development all the parameters involved have been derived solely from data at the University of Toronto. It is contemplated that data from the provincial space survey now in progress will be used to validate these parameters.

Purposes of a Capital Allocation Formula

In developing a capital allocation formula, the primary objectives should be equity and simplicity. It is imperative to ensure that faculties and departments with very high or low space requirements should be so represented in the formula; otherwise any increase in the enrolment of these faculties or departments could lead to costly shortages or excesses of space. More importantly, if any benefit is to be extracted from it the formula has to be fair in the eyes of the capital grants recipients.

Simplicity in the formula may be just as easily defended. The scale, methods of operation, and the goals of the member universities of the Province are significantly different. Any formula that attempts to regulate their capital funds with precision would have to take into account such differences. Moreover, the design of even a simple capital formula is made difficult by the limitations of data. Therefore, by raising the level of detail at which capital funds are generated and the degree with which their allocation within a given university would be controlled, a simple formula gives more freedom to the universities for allocating the monies received. We should emphasize also that there will always exist a requirement for making individual assessments of the needs of particular institutions for certain categories of funding.

Application of the Formula

The formula treats graduate and undergraduate student enrolment separately and divides all university space into two types, laboratory space and non-laboratory space (non-laboratory space includes all net assignable space not classified as laboratory space. (See Appendix AI pp. AI-7 for a description of types of space included in these two categories.) Separation into these two groups is convenient and represents a reasonable division of the two types of space which appear from preliminary study to have quite different costs. All faculties are distributed into four categories which are weighted to reflect the demand for the two basic types of space by graduate students and undergraduate subject-students[1] enrolled in these faculties.

The first category consists of all faculties requiring over 125 square feet of laboratory space per graduate student and greater than 10 square feet of laboratory space per undergraduate subject-student. The second category consists of all faculties requiring less than 125 square feet of laboratory space per graduate student and greater than 10 square feet of laboratory space per undergraduate subject-student. The third category includes those

(1) A subject-student is defined as one student enrolled in one subject. For example, a class of 100 students taking a subject generates 100 subject-students.

faculties requiring less than 125 square feet of laboratory space per graduate student and less than 10 square feet of laboratory space per undergraduate subject-student. Any faculty requiring effectively 0 laboratory space in both graduate and undergraduate sections was placed in Category IV. The categorization of faculties at the University of Toronto is presented in Section 2 of Appendix A.

The basic formula is presented in Table 1 and shows the consumption of laboratory and non-laboratory space by one graduate student and one undergraduate subject-student enrolled in each of the four categories.

Because the formula demands subject-student data at the undergraduate level and this information is not always available, a more convenient although proximated form has been devised.

TABLE 1

BASIC SPACE FACTORS

Category	Graduate		Undergraduate	
	Square Feet/Student		Square Feet/Student	
	Laboratory	Non-Laboratory	Laboratory	Non-Laboratory
I	429	135	14.6	5.7
II	74	164	23.0	9.9
III	·44	67	4.8	2.5
IV	0	77	0	10.0

Hereafter, the basic formula will be referred to as the "original" formula, while, the approximate formula will be referred to as the "simplified" formula.

The use of the original formula will be described first followed by a description of several possible applications of the simplified formula.

The primary application of the original formula, assuming that data on subject-students is available, is to determine the physical plant requirements and corresponding capital expenditures needed to meet projected enrolment increases. For graduate space needs, this is accomplished by distributing the projected additional graduate enrolment in each faculty into the four categories according to the amount of laboratory space required to meet the demands of an "average" graduate student in each faculty. If it is assumed that there is a large degree of consistency in academic nomenclature, the faculties may also be distributed on the basis of their names by referring to the grouping of Faculties at the University of Toronto in Section 2 of Appendix A.

For undergraduate space needs, the projected additional undergraduate enrolment of subject-students in each faculty is distributed into a matrix such that the intersections of a faculty with all other faculties contains the number of subject-students loaded by that particular faculty onto all other faculties (See Table 2). In this example the Faculty of Business loads 100 subject-students on the Physical Sciences division and 100 subject-students on the Social Sciences division of the Faculty of Arts and

TABLE 2

INTER-FACULTY LOADING BY SUBJECT-STUDENTS
(UNDERGRADUATE)

Faculty	Division	Business	Physical Sciences	Social Sciences	Forestry	Total Subject-Students
Business		600	200	0	100	900
Arts and Sciences	Physical Sciences	100	900	100	100	1200
	Social Sciences	100	100	200	100	500
Forestry		0	0	0	100	100

Science, zero subject-students on its own faculty. By summing across the rows of the matrix, the total number of subject-students imposed on a faculty may be obtained. Thus, the total load borne by the Faculty of Business is 900 subject-students.

The undergraduate faculty workloads, represented by subject-students, are then distributed into the four categories according to the amount of laboratory space required to meet the demands of an "average" subject-student in each faculty. Alternatively, this distribution may be achieved by reference to the faculty names, as in the case of graduate students.

The result of this distribution into categories of graduate students and undergraduate subject-students is shown in Table 3. Enrolment changes from period to period indicated in Table 3

TABLE 3

Faculty	Additional Students	
	Graduate	Undergraduate
Business	50	100
Physical Sciences	50	200
Social Sciences	20	100
Forestry	10	50
TOTAL	130	450

ADDITIONAL STUDENTS - BY CATEGORY

Category	Graduate Students	Undergraduate Subject-students
I	50	1,200
II	10	100
III	20	500
IV	50	900

are multiplied by the space consumption factors in the corresponding categories of the formula in Table 1 to generate the additional laboratory and non-laboratory space required to meet projected increases in graduate and undergraduate enrolment. The result is Table 4.

TABLE 4

SPACE CONSUMPTION BY CATEGORY

Category	Graduate		Undergraduate	
	Laboratory	Non-Laboratory	Laboratory	Non-Laboratory
I	21,450	6,750	17,520	6,840
II	740	1,640	2,300	990
III	880	1,340	2,400	1,250
IV	0	3,850	0	9,000

Total Non-Laboratory = 31,660 + 40(130+450)

= 54,860 sq. ft.

Total Laboratory = 45,290 sq. ft.

Addition of the space in each column of Table 4 gives four totals representing the laboratory and non-laboratory space required by graduate and undergraduate students. Addition of the laboratory space for graduate and undergraduate students and a similar addition for non-laboratory space yields the total laboratory and non-laboratory space required. Finally the total number of graduate and undergraduate students, irrespective of discipline, is multiplied by the ancillary space factor of 40 square feet per student and the product is added to the total non-laboratory space shown at the bottom of Table 4.

An estimate of the capital cost involved in the provision of this additional space may be obtained by applying the appropriate cost estimates for these types of space ($63 and $115 per net

assignable square foot for non-laboratory and laboratory space respectively). An outline of the derivation of these cost estimates is given in Appendix B.

Enrolment data on subject-students in universities normally is not readily available and so a method has been devised for converting undergraduate subject-students into students by applying average number of laboratory and non-laboratory subjects taken per student in each category. This simplification implies that any change in the pattern of inter-faculty loading takes place wholly within the four categories. In any event, whenever undergraduate subject-student information is available, the average number of subjects per student should be recomputed at intervals to verify that the change in value over time is small.

TABLE 5

AVERAGE NUMBER OF SUBJECTS PER UNDERGRADUATE STUDENT

FACULTY	LABORATORY	LECTURE
I	4	6
II	3	7
III	3	6
IV	0	9

For the simplified method, the computed values for the average number of laboratory and non-laboratory undergraduate subjects per student for each category are shown in Table 5.

TABLE 6

BASIC SPACE CONSUMPTION MATRIX

Category	Graduate		Undergraduate*	
	Lab	Non-Lab	Lab	Non-Lab
I	429	175	58.4	74.4
II	74	204	109	109
III	44	107	14.4	55
IV	0	117	0	130

* Dimension of Sq.Ft./Student (Converted from Sq. Ft./Subject-Student)

The simplified formula is obtained by multiplying each value of the undergraduate section of the original formula (Table 1) by the corresponding value of Table 5. This results in space factors in the undergraduate section dimensioned by square feet per student (Table 6).

TABLE 7

SPACE FACTORS

Category	Graduate			Undergraduate		
	Space	Distribution (%)		Space	Distribution (%)	
		Lab	Non-Lab		Lab	Non-Lab
I	604	71	29	133	44	56
II	278	27	73	218	50	50
III	151	29	71	69.4	21	79
IV	117	0	100	130	0	100

For comparison purposes it is convenient to cast the formula in index form. For this comparison, the laboratory and non-laboratory space demands for each category of faculties for both graduate and undergraduate students are merged and the ratios of laboratory and non-laboratory space to total space are shown separately. (See Table 7). The combined space demands in Table 7 are then divided by 69.4 (the smallest element in the array) to produce an undergraduate category of space which serves as a unit base. This produces a basic space unit multiplier of 69.4 square feet per student. (See Table 8).

TABLE 8

SPACE WEIGHTS

Category	Weights	
	Graduate	Undergraduate
I	8.7	1.9
II	4.0	3.1
III	2.2	1.0
IV	1.7	1.9

Basic Space Unit = 69.4 Square Feet

This approach to representing the formula has the advantage of making readily apparent the relative demands for laboratory and non-laboratory space by the type of student in the different categories.

In applying the simple formula, both graduate and undergraduate changes in enrolment are distributed into four space categories and then multiplied by the corresponding space factors. These "space-weighted" students are then totalled and the space unit of 69.4 square feet is applied to generate an estimate of the additional space required to meet projected changes in enrolment.

TABLE 9

PROJECTED ENROLMENT CHANGES
(1968-69 to 1975-76)

	1968-69		1975-76		Change.	
	G	UG	G	UG	G	UG
Business	50	200	250	500	200	300
Physical Sciences	400	950	550	1000	150	50
Social Sciences	300	800	400	1000	100	200
Forestry	20	170	40	200	20	30

For an example of the application of the formula, assume that the projected enrolment increase in four faculties over some convenient planning period is as shown in Table 9. These enrolment changes are distributed into the four categories and multiplied by the weights in the corresponding elements of Table 8 to produce Table 10 which shows the number of projected "space-weighted" students. The projected space-weighted students are then multiplied by the basic space unit of 69.4 square feet per student to generate an estimate of the additional space required for each type of student in each category. This total space per student is broken into laboratory and non-laboratory components by applying the relevant percentage factors for each category. This yields the laboratory and non-laboratory space required to meet the expected enrolment increase in each category (See Table 11.)

TABLE 10

ADDITIONAL "SPACE-WEIGHTED" STUDENTS BY CATEGORY
(1968-69 to 1975-76)

Category	Graduate			Undergraduate		
	Weight	Students	Weighted Students	Weight	Students	Weighted Students
I	8.7	150	1305	1.9	50	95
II	4.0	20	80	3.1	30	93
III	2.2	100	220	1.0	200	200
IV	1.7	200	340	1.9	300	570

TABLE 11

ADDITIONAL SPACE REQUIRED BY TYPE
(1968-69 to 1975-76)

Category	Graduate			Undergraduate		
	Total Space	Lab	Non-Lab	Total Space	Lab	Non-Lab
I	90,567	64,303	26,264	6,593	2,901	3,692
II	5,552	1,499	4,053	6,454	3,227	3,227
III	15,268	4,428	10,840	13,880	2,915	10,965
IV	23,596	0	23,596	39,558	0	39,558

Cost/Net Assignable Sq. Ft.

Total Non-Laboratory	122,195	X	$63	=	7,698,285
Total Laboratory	79,273	X	$115	=	9,116,395
Total Cost					$16,814,680

The columns are then added to give the total amounts of laboratory and non-laboratory space requirements which are then multiplied by the appropriate costs ($63 and $115 per net assignable square foot for non-laboratory and laboratory space respectively).

This procedure assumes that the existing space is adequate to meet the present enrolment. If this is not the case the formula may be applied in the following way. Instead of applying the formula to the projected increase in enrolment, the total projected enrolment is distributed into the four categories and the expected demand for laboratory and non-laboratory space is calculated as before. Then the existing laboratory and non-laboratory space is subtracted to give an estimate of future space requirements. The cost can then be computed as before.

A third way in which the formula may be used is to calculate the degree to which the presently available space meets the needs of current enrolment. This is a fairly obvious variation of the first procedure and is accomplished by computing the space needed to satisfy the present enrolment level by applying the formula and comparing it with the space presently in existence.

Finally, dividing the capital costs estimated to meet an expected level of enrolment by the total space weighted student projection yields a cost per additional space weighted student.

APPENDIX A

SECTION 1

A Statement of the Problem

The problem as seen by the authors is one of determining the amounts of the two basic types of space (laboratory or non-laboratory) needed by each type of student enrolled in the university system. Thus, any mix of new students expected in any university of the system could be weighted according to type to generate the new space required. A capital cost could then be estimated for the projected space requirements by applying the proper building cost factors.

Data limitations and the need for a simple formula rule out immediately operation at this level of detail. The lowest level of detail on student enrolment that was universally and readily available at the University of Toronto was subject-students taught by faculties. Therefore, three assumptions became immediate constraints on the analysis.

First, it is assumed that the average demand for space by different types of students in any given year within a faculty will not change appreciably over short periods of time. Second, the distribution of undergraduate students in different years within a faculty is assumed constant over short periods of time. The third basic assumption stems from the fact that no well-defined standards of space requirements for ultilization of different types of space exist. In a comparative study it was found that the University of Toronto's statistics on such overall standards as classroom space per student, average net assignable space per

student, and average square footage of office space per staff member are comparable with the corresponding averages of universities of similar size in the United States. It is therefore assumed that the efficiency with which the departments at the University of Toronto use their existing space is acceptable and can be used as the basis for projecting future space needs.

These three major assumptions underly the methodology adopted in this paper for devising a capital grants formula.

A Description of the Available Data

The year 1967-68 was used for developing the formula. This was the year in which our first complete inventory of space became available. However, the only enrolment data available for the 1967-68 session was the number of students enrolled by faculty. Moreover, it was recognized that the Faculty of Arts and Science encompassed too great a variety of disciplines to avoid violating the first assumption made about student demand for space. Fortunately, in 1965-66 a survey had been conducted of the number of subject-students in each faculty and group of departments within the Faculty of Arts and Science which could be distributed pro-rata for the determination of subject-student loading by faculty for the 1967-68 session. It was also thought that departments within the Faculty of Applied Science and Engineering could have differing space needs. However, analysis by department showed this not to be the case and the faculty was kept as a unit.

The problem of multi-disciplines within the Faculty of Arts and Science was overcome by using the subgroupings of Humanities, Social Sciences, Physical Sciences and Life Sciences and treating each of them as a Division. A consideration of the similar nature of the disciplines offered by the departments within the subgroupings as well as a comparison of some incomplete departmental enrolment and space estimates suggested that this assumption would not be a very limiting one.

To deal with the problem posed by the inter-faculty student loading and the lack of subject-student information for 1967-68, an assumption was made that the average number of subjects per student in each faculty had not changed appreciably from the situation which had prevailed in 1965-66. On this basis, it became possible to estimate inter-faculty subject-student loading in 1967-68 as shown in the following example.

TABLE 12

SESSION 1965-66

Enrolment		1,616	8,131	98	Total
Division	Faculty	Applied Science & Engineering	Arts & Science	Forestry	Subject-Students
	Applied Science & Engineering	9,421	13	79	9,513
Physical Sciences	Arts & Science	3,093	7,722	135	10,950
	Forestry	-	-	372	372
Check		12,514	7,735	586	20,835

In Table 12 the following data are assumed known for the academic year 1965-66:

a) enrolment in each faculty.

b) number of subject-students receiving instruction from a faculty and the faculty of origin of each subject-student.

In the example of Table 12 the Faculty of Applied Science and Engineering is loaded with 9,421 subject-students from its own Faculty, 13 subject-students from the Faculty of Arts and Sciences, and 79 subject-students from the Faculty of Forestry. The Faculty of Applied Science and Engineering causes a loading of 9,421 subject-students on its own Faculty and 3,093 subject-students on the Physical Sciences division of the Faculty of Arts and Science.

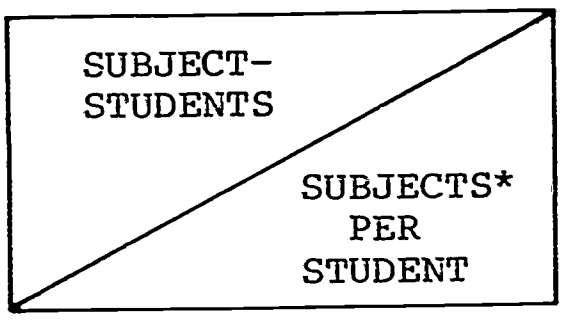
From these data it is then possible to calculate the average number of subjects taken per student enrolled in a faculty. An average student enrolled in the Faculty of Applied Science and Engineering, for example, takes 9,421/1,616 = 5.8 courses of instruction from the Faculty of Applied Science and Engineering and 3,093/1,616 = 1.9 from the Physical Sciences division of the Faculty of Arts and Science making a total of 7.7 courses of instruction. Table 13 is a reproduction of Table 12 with the average number of subjects per student calculated for each faculty in the session 1965-66.

TABLE 13

SESSION 1965-66

Enrolment		1,616	8,131	89	Total
Division	Faculty	Applied Science & Engineering	Arts & Science	Forestry	Subject-Students
	Applied Science & Engineering	9,421 / 5.83	13 / .0016	79 / .89	9,513
Physical Sciences	Arts & Science	3,093 / 1.91	7,722 / .95	135 / 1.52	10,950
	Forestry			372 / 4.18	372
Check		12,514	7,735	586	20,835

Legend



*Subjects/Student = Subject-Students/Faculty Enrolment

If the enrolment in each faculty in 1967-68 is known an estimate can be made of the number of subject-students taught by each faculty by applying the calculated 1965-66 factors of subjects per students to the 1967-68 enrolment data. Thus, 3,940 subject-

students have been generated as the estimated load of the Faculty of Applied Science and Engineering on the Division of Physical Sciences for the session 1967-68. Summing across the rows of Table 14 generates the total number of undergraduate subject-students loaded onto each faculty.

TABLE 14

SESSION 1967-68

FACULTY	ENROLMENT (1967-68)
Applied Science & Engineering	2,063
Arts and Science	8,717
Forestry	138

Enrolment		2,063	8,717	138	Total
Division	Faculty	Applied Science & Engineering	Arts & Science	Forestry	Subject-Students
Physical Sciences	Applied Science & Engineering	12,027 / 5.83	14 / .006	123 / .89	12,164
	Arts and Science	3,940 / 1.91	8,281 / .95	210 / 1.52	12,431
	Forestry	-		577 / 4.18	577
Check		15,967	8,295	910	25,172

The other available data file consisted of a breakdown by faculty, department, building and space category of all the net assignable area at the University of Toronto, except for the Clinical Sciences component of the Health Sciences. These space categories are for the most part self-explanatory and are listed in Section 3 of Appendix A. In this file all types of assignable space used by a department or faculty had been claimed except for common classroom space, which is regarded as being available for allocation to any faculty by Central Room Allocation. The last five categories shown in Section 3 of Appendix A are all non-assignable space and did not enter into any calculations in this paper.

The space data were summarized into laboratory and non-laboratory space by faculty and distributed to graduate and undergraduate students in the following manner:

1. Graduate Laboratory

This category includes research offices, research office service, research laboratory, research special laboratory and research special laboratory service.

2. Graduate Non-Laboratory

This category includes:

(a) Departmental or faculty libraries, library offices, library study and library study service areas. This is true for all faculties except Food Science, Law and Dentistry where there is reason to suspect that equivalent usage is made by undergraduates of this type of space. Therefore, for these faculties

only a portion equal to the proportion of graduate students to total faculty enrolment is included.

(b) A proportion of the main library where that proportion is determined by usage. Graduates = 25%, Undergraduates = 75%, Wallace Room, Humanities and Social Sciences = 77% and Science and Medicine = 23%.

(c) A proportion of academic and administrative office space. This was determined from the 1965-66 estimates of ratios of full-time equivalent academic staff engaged in graduate instruction and supervision to total academic staff in a faculty.

(d) A proportion of faculty service space determined from the ratio of graduate students to total students in faculty. Faculty service space included such categories as faculty office space and in the case of Arts and Science, a proportion of faculty administrative space was distributed among the four sub-groups of the faculty. It also includes assigned classroom space and assigned classroom service space, common rooms and a proportion of the computer centre where the proportion is determined by usage.

(e) A factor of 40 square feet per student, for general classroom space, physical education facilities and general administrative space (central administration, physical plant, bookstore and press facilities).

3. Undergraduate Laboratory

This category includes (a) instructional laboratories; (b) special instructional laboratories and (c) instructional laboratories service areas.

4. Undergraduate Non-Laboratory

This category is derived in a manner analagous to graduate non-laboratory, including the 40 square feet per student for ancillary space.

For each faculty, graduate enrolment, undergraduate lecture subject-students and undergraduate laboratory subject-students and the laboratory and non-laboratory space for graduates and undergraduates were entered into a table shown in Table 15. From this the laboratory and non-laboratory square footages per graduate student and per undergraduate subject-student in each faculty were obtained. The resulting data were then examined with a view to creating categories of faculties with approximately the same requirements for space. The minimum number of well-defined categories resulting from this inspection are as shown in Section 2 of this Appendix. The mean laboratory and non-laboratory square footages per student for graduates and per subject-student for undergraduates of those faculties falling in each category were then computed to yield Table 1 on Page 5. In the opinion of the authors these represented a reasonable estimate of the space needs of the various faculty groupings for graduate and undergraduate demands for the two main types of space.

To relate the assignable space which is considered to be shared more or less equally by everyone in the university regardless of discipline and not claimed by any faculty, the total square footage of such general space was divided by the total number of students (graduate and undergraduate). This generated a figure of 40 square feet per student of general service space

to be added to the total non-laboratory space required by the faculties (See bottom of Table 4 page 9).

TABLE 15

CALCULATION OF SPACE FACTORS

	GRADUATE			UNDERGRADUATE				GRADUATE		UNDERGRADUATE	
COLUMN	1	2	3	4	5	6	7	2—1	3—1	6—5	7—4
	FTE STUDENTS	LAB	NON—LAB	LECTURE SUBJECT—STUDENTS	LAB SUBJECT—STUDENTS	LAB	NON—LAB	LAB	NON—LAB	LAB	NON—LAB
DIMENSION / FACULTY		SQ. FT.	SQ. FT.			SQ FT.	SQ FT.	SQ FT / FTE STUDENT	SQ FT / FTE STUDENT	SQ FT / LAB SUBJ—STUDENT	SQ FT / LECT SUBJ—STUDENT
APPLIED SCIENCE AND ENGINEERING	158	159,628	49,395	12,362	10,769	129,914	79,535	397	95	12	6·4
PHYSICAL SCIENCES	484	173,283	48,802	14,166	9,043	111,737	49,426	358	101	11	3·5
FORESTRY	23	1,660	3,204	580	417	5,259	3,491	72	139	13	6·9

SECTION 2

Faculties Included in Categories

Category I

a) Applied Science and Engineering

b) Pharmacy

c) Life Sciences*

d) Physical Sciences*

e) Dentistry

f) Food SCience

g) Hygiene (graduate section only)

h) Law (graduate section only)

Category II

a) Architecture

b) Forestry

c) Nursing

Category III

a) Hygiene (undergraduate section only)

b) Humanities (undergraduate section only)*

c) Social Sciences*

d) Linguistic Studies

Category IV-

a) Business

b) Music

c) Social Work

d) Medieval Studies

e) Humanities (graduate section only)

f) Law (undergraduate section only)

*These are Arts and Science groupings which include the following departments:

1. Humanities - East Asian Studies, History, Islamic Studies, Italian and Hispanic Studies, Philosophy and Slavic Studies.
2. Social Sciences - Anthropology, Geography, Political Economy, Sociology and Mathematics.
3. Physical Sciences - Chemistry, Physics, Geology, and Astronomy.
4. Life Sciences - Botany, Zoology and Psychology.

SECTION 3

SPACE CATEGORIES

Assignable Area

Classroom

Classroom Service

Assignable Classroom

Instructional Laboratory

Instructional Special Laboratory

Instructional Laboratory Service

Adminstrative Office

Administrative Office Service

Academic Office

Academic Office Service

Physical Education

Physical Education Service

Library Office

Library Office Service

Library Study

Library Study Service

Auditorium

Auditorium Service

Research Office

Research Office Service

Research Laboratory

Research Special Laboratory

Research Laboratory Service

Extension Office

Extension Office Service

General Service

Physical Plant

Warehouse

Inactive

Non-Assignable Area

Custodial

Circulation

Mechanical

Rest Room

Construction

APPENDIX B

To derive a dollar estimate for construction costs of laboratory and non-laboratory space, the actual building costs (excluding equipment) of the major academic buildings constructed during the past fifteen years are inflated using an index supplied by Physical Plant, to bring them to a base year (1966). Using the space inventory information this group of buildings is divided into two sub-groups according to whether they contain predominantly laboratory space or non-laboratory space and the areas of each type of space in each group are obtained. Then, assuming that it costs \$X per square foot to construct laboratory space and \$Y per square foot for non-laboratory space, two linear equations may be found:

$$S_1X + S_2Y = C_1$$

$$S_3X + S_4Y = C_2$$

where S_1, S_2, S_3, and S_4 are the known areas of laboratory and non-laboratory space in each of the two sub-groups of buildings, and C_1 and C_2 are the total costs of the two sub-groups of buildings inflated to a base year (1966). These equations are then solved simultaneously for X and Y.